Operative and Non-Operative Outcomes in Trisomy 13 and 18 Patients with Congenital Heart Disease

Methods

Retrospective chart review of all Trisomy 13 (T13) and Trisomy 18 (T18) patients undergoing primary cardiac repair vs non-operative management at Boston Children’s Hospital from 1985 to 2023.

- 62 patients (34 operated, 28 non-operated)
- T13 (n=9), T18 (n=53)
- 74% female
- 71% STAT 1 cases, most commonly VSD
- Median age at OR 2.5 months (IQR 1.5-4.5)

Results

- Post-Cp median ICU stay 6.5 days (IQR 3.7-15)
- Total Hospital LOS 15 days (IQR 11-45)
- 30-day Post Op Survival 92%
- Median FU 15.4 months (IQR 1.2-48.3)
- Non-Operated vs Operated: One-year Operated Survival 79% vs 53.5% Non-Operated (P=0.003)
- Non-Cp Treatment Increased risk of mortality (HRa=3.28, 95% CI: 1.46, 7.4, P=0.004)

Implications

Cardiac repair can be performed safely with low early mortality and operated patients had higher long-term survival compared to non-operated in our cohort.
Operative and Non-Operative Outcomes in Trisomy 13 and 18 Patients with Congenital Heart Disease

Christina L. Greene¹, MD, Antonia Schulz¹, MD, Mariana Chávez¹, MD, Steven J. Staffa², MS, David Zurakowski², MS, PhD, Kevin G. Friedman³, MD, Sitaram M. Emani¹, MD, Christopher W. Baird¹, MD.

¹Department of Cardiac Surgery, ²Department of Anesthesiology, Critical Care and Pain Medicine ³Department of Cardiology: Boston Children’s Hospital, Harvard Medical School, Boston, Mass.

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Corresponding Author:

Christina L. Greene, MD
Congenital Cardiothoracic Surgery
Seattle Children’s Hospital
4800 Sand Point Way NE
Seattle, WA 98105
Christina.Greene@seattlechildrens.org
GLOSSARY OF ABBREVIATIONS:

STAT: The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery

T13: Trisomy 13

T18: Trisomy 18

CENTRAL MESSAGE:

Primary cardiac repair is safe and effective in T13/T18 patients with CHD and can greatly improve survival. Despite comorbidities, most families are satisfied with their child’s quality of life.

PERSPECTIVE STATEMENT:

Primary cardiac repair in T13/T18 patients with CHD is controversial. Here we demonstrate it is safe and effective when standard operative criteria are followed and can greatly improve survival. Despite a high burden of morbidities, most families are satisfied with their child’s quality of life. We advocate for early referral for primary cardiac repair in T13/T18 patients with CHD.

Central Picture Legend

Operated patient survival was significantly higher than Non-Operated (P<0.001).


**STRUCTURED ABSTRACT** (Word Count: 248/250)

**Objective:** To evaluate the short and long-term outcomes of cardiac repair vs non-operative management in Trisomy 13 (T13) and Trisomy 18 (T18) patients with congenital heart disease (CHD).

**Methods:** An IRB approved, retrospective review was undertaken to identify all patients admitted with T13/T18 and CHD. Patients were divided into two cohorts (operated vs. non-operated) and compared.

**Results:** Between 1985 and 2023, 62 patients (34 operated, 28 non-operated) with T13 (n=9) and T18 (n=53) were identified. The operated cohort was 74% female, underwent mainly STAT mortality category 1 procedures (n=24, 71%) at a median age of 2.5 months (IQR 1.3-4.5). This compares to the non-operative cohort where 64% (n=18) would have undergone STAT 1 procedures if surgery would have been elected. Most common diagnosis was ventricular septal defect. Postoperative median ICU stay was 6.5 days (IQR 3.7-15) with a total hospital LOS of 15 days (IQR 11-49). 30-day postoperative survival was 94%. There were five in-hospital deaths in the operated and seven in the non-operated cohort. Median follow up was 15.4 months (IQR 4.3-48.7) for the operated and 11.2 months (IQR 1.2-48.3) for the non-operated cohort. One year survival was 79% operated vs 51.5% non-operated, P<0.003. Non-operative treatment had an increased risk of mortality (HR=3.28, 95% CI: 1.46, 7.4, P=0.004).

**Conclusions:** Controversy exists regarding the role of primary cardiac repair in patients with T13/T18 and CHD. Cardiac repair can be performed safely with low early mortality and operated patients had higher long-term survival compared to non-operated in our cohort.

**KEYWORDS:**

Trisomy 13, Trisomy 18, Congenital Heart Disease
INTRODUCTION

Trisomy 13 and Trisomy 18 are the most common Trisomy disorders following Trisomy 21 with a prevalence of 1.68 and 4.08 per 10,000 live births respectively. Patients present with a variety of anomalies including cleft palate, genitourinary malformations, brain and spinal cord deformities and CHD. Almost 90% of patients with T13 and T18 have associated congenital heart defects. Most commonly ventricular septal defects (VSD), patent ductus arteriosus (PDA) and atrial septal defects (ASD). Unlike T21, T13 and T18 patients are often viewed to have such a dismal prognosis that they are not routinely referred for repair. Instead, the majority are sent home to hospice without surgical consultation mirroring the experience of T21 patients fifty years ago. Without intervention, the median mortality within the first week of life is reported to be 47% for T13 and 42% for T18 with the largest international registry reporting a one year mortality of 87% for T13 and 88% for T18.

For the last decade it has been the practice at our institution to offer primary cardiac repair to patients with T13/T18 and two-ventricle heart disease with the rational that it improves patient survival and quality of life for the patient and the family. Specifically, the diagnosis of T13/T18 is not a disqualifying metric for repair. These patients were evaluated against the same criteria that patients without a trisomy diagnosis were measured against. More recently, with the advent of social media and online disease specific forums, families are seeking out surgical programs willing to operate on their children when their local institutions refuse to offer cardiac repair highlighting the disparate views of this diagnosis. Few studies compare primary cardiac repair to medical management, and conclusions are limited by small sample size. We present our short and long-term outcomes of primary cardiac repair vs non-operative management in T13 and T18 patients in order to aid treatment decision.
METHODS

A retrospective review was performed to identify all patients admitted with a diagnosis of T13 or T18 and CHD between November 1985 and October 2023. The study was approved by the institutional review board (IRB-P00033023, 9/3/2019) and patient consent was waived. Patients with T13 or T18 with a cardiac defect were identified from the cardiac surgery and cardiology database. Mosaic T13/T18 patients were excluded as they are generally viewed to have a milder form of the syndrome.\textsuperscript{18,20} Primary endpoint was survival, and secondary endpoints were cost and patient’s health status.

The patients were sub-divided into two groups: operated and non-operated. Treatment choice was made by the family after interdisciplinary consultation. Surgical treatment was not offered for single ventricle disease. Demographic, prenatal, postnatal, echocardiographic, catheterization, operative, follow-up and cost data were collected and analyzed. Follow-up for survival analysis was obtained in 100% of operated and 88% of non-operated patients.

Statistical Analysis

Patient and operative characteristics are represented as number (percent) for categorical variables and median and interquartile range for continuous variables. Wilcoxon rank sum test for continuous and Fisher's exact test for categorical data comparisons were used. Kaplan-Meier survival curves were compared between operated and non-operated groups by log-rank test with numbers at risk presented for each year of age. Multivariable Cox proportional hazards regression analysis was used to determine the independent predictors of mortality. The multivariable model was created using stepwise backwards elimination with criterion for
removal of $P>0.1$ to fit a parsimonious model. All statistical analyses were performed using Stata (version 17.1, StataCorp LLC, College Station, Texas) and a two-tailed $P < 0.05$ was considered statistically significant.

RESULTS

Baseline Characteristics:
Between 1985 and May 2023, 62 patients with T13 ($n=9$) or T18 ($n=53$) and CHD were evaluated. Figure 1 shows the evolution of patients treated at our center over time. Gestational age was 37 weeks (36, 39) and birth weight was 2.08 kg (1.8-2.4). 79% of patients were female ($n=49$). The most common congenital heart defects were atrial and ventricular septal defects (Table 1). Eleven patients (18%) had duct dependent lesions and seven patients (11%) had arch hypoplasia. Pre-natal diagnosis was known in 35 patients (56%) and intra-uterine growth retardation (IUGR) was present in 26 patients (42%). The most common concomitant lesions were structural brain deformities ($n=37, 59\%$) and structural kidney deformities ($n=16, 26\%$).

The study population was then divided into an Operated ($n=34$) and Non-Operated ($n=28$) cohort. Baseline characteristics were similar between the two groups on multi-variable analysis (Table 2). There was no difference in the rates of pre-operative mechanical ventilation or pulmonary hypertension. The only difference was 67% of the Non-Operated cohort were initially sent home ($n=19$) while only 32% of the Operated cohort ($n=11$) were. In the Non-Operated cohort, 9 patients had bidirectional flow across the VSD (32%) and underwent catheterization. All 9 were found to have elevated pulmonary vascular resistance (PVR) 14.7WU (IQR 14.1, 25). In the Operated cohort, bi-directional flow across the VSD was seen in 15 patients (44%). Eight patients underwent catheterization with 6 diagnosed with elevated PVR.
Operative Details:

Overall, 34 patients underwent 35 operations. Patients weighed 2.95 kg (IQR 2.2-4.3) at the time of repair and were taken to the operating room at a median of 2.5 months (IQR 1.35-4.5). Mechanical ventilation was required pre-operatively in 44% (n=15), and 26% (n=9) had been treated for a previous infection with IV antibiotics. Nine patients (26%) had a gastrostomy tube in place at the time of operation. Cardiac diagnoses are listed in Table 1. Suprasystemic right ventricular (RV) pressures were present in 9 patients (26%). Eight patients (24%) underwent pre-operative catheterization with only one patient receiving a PDA stent.

The most common procedures were ASD/VSD closures (74%, n=28). Distribution of STAT mortality categories are presented in Figure 2. Cardiopulmonary bypass time (CPB) was 107 min (IQR 82-134), and cross clamp time (XC) was 73 min (IQR 61-94). All patients successfully weaned off CPB. Post-operative echocardiogram showed good biventricular function in 94% (n=32). Patients were extubated 6 days post-operatively (IQR 3-10). Eleven patients (32%) required post-operative tracheostomy with one patient known to be decannulated. Of these, six (54%) required mechanical ventilation pre-operatively. Only 3 patients were able to establish oral feeds post-operatively. Thirteen were fed via nasogastric tube and 10 were fed via gastrostomy tube at discharge. Patients were transferred to the floor 6.5 days post-operatively (IQR 3.75-15). Total length of stay (LOS) was 15 days (IQR 11.25-49).

Operated vs Non-Operated Survival

There was a 25% mortality rate (n=7) during the first 30 days of life in the Non-Operated cohort vs 3% (n=1) in the Operated group. Postoperative 30-day survival was 94% (n=32). Follow up of
the Operated and Non-Operated patients was 15 months (IQR, 4-49) and 11 months (IQR, 1.2-48) respectively. Survival at 1, 3 and 5 years for the operated cohort was 79%, 76%, and 70% while survival for the non-operated cohort was 52%, 39% and 35%, P<0.001 (Figure 3).

Of those operated, six died of sepsis and respiratory failure while one died of multi-organ failure. Of these, four (67%) were ventilated pre-operatively. The most common cause of death in the Non-Operated group was respiratory failure (n=5), followed by withdrawal of care (n=4) and infection (n=2). Two patients arrested while having outpatient procedures (urologic repair and tonsillectomy). Non-operative treatment had an increased risk of mortality, adjusted HR=3.28 (95% CI: 1.46, 7.4 P=0.004) adjusting for pulmonary hypertension and structural kidney disease.

Improved survival for the operated patients was observed throughout the course of the study and when T13 and T18 patients were evaluated individually (Figure 4). Non-Operated T13 patients had the worst survival overall. Currently, there are seven long-term survivors with more than 5 years of follow-up in the Operated group vs three in the Non-Operated group. All patients have Trisomy 18.

Patient’s health status

Of patients alive, 63% (15/24) of Operated vs. 71% (5/7) of Non-Operated patients were described by their parents as doing well in their last clinic note. In the Operated cohort three patients (13%) have seizures which significantly reduce their quality of life and three are ventilator dependent (13%). Two operated patients were noted to be attending school while one patient, age 39-years old, lives independently. In the Non-Operated cohort, four patients were suffering from congestive heart failure and pulmonary hypertension (66%).
Number of Admissions and Cost

Admission and cost data was available for 47 patients. The number of admissions for alive patients in the Operated cohort was 1 (IQR 1-3.75) over 54 months (IQR 9.6-99) vs 2 (IQR 1.5-3.5) over 47 months (IQR 37-60) in the non-operated cohort (P=0.67). Operated patients were in hospital longer than Non-Operated patients (34 vs. 12 days, P=0.034) with greater total hospital charges ($210,754 vs. $53,050, P=0.22) (Table 3). On average they received more echocardiograms (6 versus 3, P=0.016) and a similar number of catheterizations. Total cost per year of life was more in the Non-Operated group than the Operated group though this was not statistically significant ($70,743 vs $25,487).

COMMENT

This study evaluates the short and long-term outcomes of primary cardiac repair vs non-operative management in T13 and T18 patients with CHD at a large tertiary referral pediatric hospital. Over a 39-year period, 62 patients with T13/T18 and CHD were admitted to our hospital with steadily increasing numbers over the last decade. Over half of the patients (55%, n=34) underwent cardiac repair which is higher than previously reported. This results from an institutional approach to offer definitive surgical repair rather than palliation to families when possible. Of note, one patient with multiple muscular VSDs underwent PAB placement prior to definitive repair. It also likely reflects the trend that families seeking treatment for their children get increasingly referred to our center. The decision to pursue surgery is made after extensive multidisciplinary counseling. The majority had simple cardiac lesions, mainly VSDs, that are amenable to durable repair and associated with low mortality (100% 30 Day survival) in the general population. More complex lesions that require multiple interventions like pulmonary atresia or double outlet right
ventricle were exclusively treated non-operatively. However, the operative cohort certainly also includes complex procedures such as aortic arch repair. There was no difference seen in STAT distribution between groups.

Aside from the families’ wishes the most important determinant of operative candidacy in two-ventricle T13/T18 patients with CHD is the presence of pulmonary hypertension. Patients with evidence of pulmonary hypertension on echocardiogram (i.e., bidirectional flow across the VSD) were referred for catheterization. Those found to have elevated PVR were managed non-operatively as the window to benefit from operative closure of the VSD had passed. These same operative criteria apply to non-Trisomy patients. Age at the time of catheterization in the non-operative group was 289 days (IQR 248-621) vs the 81 days (IQR 51-161) in the operative group, though due to small sample size this did not achieve statistical significance (P=0.15). For this reason, we advocate for early operative evaluation, so families still have the option for operative repair if they so choose.

Our Non-Operated cohort had a 30-day mortality of 25% and 5-year mortality of 65.4%. This compares to data from the largest international registry with reported median mortality within the first week of life of 47% for T13 and 42% for T18 and one-year mortality of 87% for T13 and 88% for T18. In contrast, the Operated cohort had a postoperative 30-day mortality of 6% and 5-year mortality of 30%, highlighting that surgical repair can be safely performed in T13/T18 patients and a considerable number might survive long-term if treated. As this study does not include all patients born with T13/T18 and CHD and there was no prospective allocation to a treatment group, there is certainly some selection bias, and it is unclear how many patients died prior to referral.
Nevertheless, the long-held belief that T13/T18 and CHD is universally fatal in infancy can’t be supported by our data and seems outdated and incorrect (Figure 5). Most of our patients were born after 2010 and therefore represent a much more contemporary cohort compared to previously published series. Additionally, it should be noted, that while the 30-day survival was 75% without intervention, it decreased to 28% by 6-month which suggests a window for possible intervention passing. These survival rates are in sharp contrast to previous reports by Rasmussen of 1-month survival of 30% and 6-month survival of 10-15% in a cohort from 1968 to 1999.

Apart from potential selection bias, important advances in critical care have occurred over the past decades which might also improve our patient’s overall survival. Central apnea is a known comorbidity of T13/T18 patients and an important determinant of survival. It has become our practice to use chronic CPAP therapy and or perform tracheostomies for patients exhibiting life threatening central apnea. Thus, 32% of our repaired patients have tracheostomies and are ventilator dependent which is reflective of the underlying condition rather than a post-operative complication. It should be noted that half of the patients that did not survive in the operative cohort were vent dependent at the time of operation (5/10). Additionally, almost all patients will require access for enteral nutrition as only three patients in our cohort were able to achieve oral feeds. The likelihood of requiring post-operative mechanical ventilation and feeding tubes should be discussed with families pre-operatively so the family’s goals of care can be aligned with the expected outcome. It is important to note that 19% of patients in the non-operative cohort died after withdrawal of care.

Non-withstanding the rate of post-operative mechanical ventilation, 63% of families with living children describe their child as happy and doing well. Despite ventilator dependence, seizure disorder limited quality of life in 18%. While quality of life could not be assessed with a validated
questionnaire, data from chart review reflects family satisfaction. Our findings are consistent with a recent study from the University of Nebraska where parents described their child’s quality of life as “high.” These data in concert with operative outcomes are incredibly important to families trying to make a well-informed decision about the best course of action for their child and what to expect long-term.

Our cost analysis was inconclusive in showing a significant financial difference between operative and non-operative management of patients with T13/T18 and CHD. Patients in the Non-Operated group accumulated significant cost over a brief period of time and then died, while patients in the Operated group accumulated significant cost and survived.

While the cohort size limited our ability to make direct comparisons between those patients that survived and those that did not in the operated cohort, patients which did well exhibited the following trends: age at OR of 2.1 months (IQR 1.45-4.79), weight > 3.09kg (IQR 2.47-4.58), and gestational age > 37 weeks gestation. Non-survivors tended to be older at operation, 2.8 months (IQR 1.38-3.47), weigh less, 2.5 kg (IQR 2.15-3.2), be preoperatively ventilated (5/10) and have more structural brain abnormalities (7/10) than survivors.

LIMITATIONS
This is a retrospective study of a rare disease affecting a small cohort of patients. While we did include all patients admitted to our hospital, our cohort is not representative of all T13/T18 patients as many parents seeking treatment rather than palliation presented to our center, devoted to the care of their children, which might have positively influenced overall outcome. There was no structured quality of life assessment and data is limited to chart review. Rigorous quality of life metrics are the focus of a forthcoming separate publication. Our cost analysis only covers the
admission and charges accrued at our center. Some patients received additional care at their local centers which was not captured.

CONCLUSIONS

In conclusion, while primary cardiac repair in patients with T13/T18 and CHD is controversial, we demonstrate that primary cardiac repair is safe and effective in patients with T13/T18 and CHD, who meet standard operative criteria, and can greatly improve survival. Despite a high burden of comorbidities, most families are satisfied with their child’s quality of life. Therefore, we advocate for early referral and consideration of primary cardiac repair in children with T13/T18. Detailed family counseling is needed regarding long-term comorbidities and treatment decisions remain center and individual choice.
REFERENCES


### Table I: Congenital Heart Defects in the Operated and Non-Operated Patients

<table>
<thead>
<tr>
<th>Operated group (n=34)</th>
<th>Non-operated Group (n=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic arch hypoplasia, CoA, multiple VSDs, PDA, PFO (7)</td>
<td>AVC</td>
</tr>
<tr>
<td>ASD, PDA</td>
<td>DORV, VSD, PA, dysplastic AV, PDA, PFO</td>
</tr>
<tr>
<td>CoA</td>
<td>DORV, VSD, PDA (2)</td>
</tr>
<tr>
<td>Multiple Muscular VSDs, ASD, PDA</td>
<td>Mitral Dysplasia</td>
</tr>
<tr>
<td>Multiple VSDs, s/p PAB</td>
<td>TOF/AVSD</td>
</tr>
<tr>
<td>TOF, ASD, PDA (2)</td>
<td>TOF/ PA/PDA (3)</td>
</tr>
<tr>
<td>Tracheoinnominate fistula, vascular ring</td>
<td>VSD (5)</td>
</tr>
<tr>
<td>VSD (3)</td>
<td>VSD, ASD (9)</td>
</tr>
<tr>
<td>VSD, ASD (5)</td>
<td>VSD, ASD, PDA (2)</td>
</tr>
<tr>
<td>VSD, ASD, PDA (5)</td>
<td>VSD, MR, TR, AR</td>
</tr>
<tr>
<td>VSD, PFO, PDA (6)</td>
<td>VSD, PDA (2)</td>
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<tr>
<td>VSD, PFO, PDA, Severe AI</td>
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Table 2: Comparison of Baseline Factors Between Operated and Non-Operated Patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Operated Group (n=34)</th>
<th>Non-operated Group (n=28)</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>Female</td>
<td>25 (73.5%)</td>
<td>24 (85.7%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (26.5%)</td>
<td>4 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Trisomy</td>
<td></td>
<td></td>
<td>0.999</td>
</tr>
<tr>
<td>Trisomy 13</td>
<td>5 (14.7%)</td>
<td>4 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Trisomy 18</td>
<td>29 (85.3%)</td>
<td>24 (85.7%)</td>
<td></td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>37 (35, 41)</td>
<td>38 (36, 39)</td>
<td>0.453</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>2.2 (1.8, 2.5)</td>
<td>2 (1.8, 2.2)</td>
<td>0.329</td>
</tr>
<tr>
<td>Pre-natal diagnosis</td>
<td>23/32 (71.9%)</td>
<td>15/25 (60%)</td>
<td>0.404</td>
</tr>
<tr>
<td>IUGR</td>
<td>16 (47.1%)</td>
<td>13/26 (50%)</td>
<td>0.821</td>
</tr>
<tr>
<td>Initially sent home</td>
<td>11 (32.4%)</td>
<td>19 (67.9%)</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Cleft palate</td>
<td>5 (14.7%)</td>
<td>6 (21.4%)</td>
<td>0.523</td>
</tr>
<tr>
<td>PHTN</td>
<td>7/33 (21.4%)</td>
<td>12 (42.9%)</td>
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</tr>
<tr>
<td>TEF</td>
<td>3 (8.8%)</td>
<td>1/27 (3.7%)</td>
<td>0.623</td>
</tr>
<tr>
<td>Structural brain anomalies</td>
<td>21 (61.8%)</td>
<td>16/25 (64%)</td>
<td>0.999</td>
</tr>
<tr>
<td>Structural kidney</td>
<td>11 (32.4%)</td>
<td>8 (28.6%)</td>
<td>0.788</td>
</tr>
<tr>
<td>Ventilator support</td>
<td>17 (50%)</td>
<td>8 (28.6%)</td>
<td>0.12</td>
</tr>
<tr>
<td>Duct dependent</td>
<td>5/33 (15.2%)</td>
<td>5 (17.9%)</td>
<td>0.999</td>
</tr>
<tr>
<td>ASD</td>
<td>23/31 (74.2%)</td>
<td>22 (78.6%)</td>
<td>0.766</td>
</tr>
<tr>
<td>VSD</td>
<td>29/32 (90.6%)</td>
<td>26 (92.9%)</td>
<td>0.999</td>
</tr>
<tr>
<td>Arch hypoplasia</td>
<td>6/32 (18.8%)</td>
<td>2 (7.1%)</td>
<td>0.264</td>
</tr>
<tr>
<td>Pulmonary HTN</td>
<td>6/8 (75%)</td>
<td>9/9 (100%)</td>
<td>0.206</td>
</tr>
</tbody>
</table>

Data are presented as median (interquartile range) for continuous data and frequency (percent) for categorical data.
P values were calculated using the Wilcoxon rank sum test and Fisher's exact test.
*Statistically significant.
### Table 3: Comparison of Accrued Costs and Procedures by Operated Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Operated Group (n=20)</th>
<th>Non-operated Group (n=27)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years Alive</strong></td>
<td>6.5 (0.9 - 11)</td>
<td>1.8 (0.05 - 5)</td>
<td>0.027*</td>
</tr>
<tr>
<td><strong>Days in Hospital</strong></td>
<td>34 (16 - 146)</td>
<td>12 (4 - 59)</td>
<td>0.034*</td>
</tr>
<tr>
<td><strong>Total Hospital Charges ($)</strong></td>
<td>210,754 (21,995 - 1,126,312)</td>
<td>307,089</td>
<td>0.227</td>
</tr>
<tr>
<td>Total Hospital Charges per Year</td>
<td>139,165 (3,662 -</td>
<td>940,312</td>
<td>0.518</td>
</tr>
<tr>
<td><strong>Total Hospital Charges per Day in Hospital</strong></td>
<td>49,553 (1,326 - 379,194)</td>
<td>940,312</td>
<td>0.518</td>
</tr>
<tr>
<td><strong>Total Hospital Cost ($)</strong></td>
<td>100,526 (13,563 - 556,457)</td>
<td>70,743 (1,639 - 571,389)</td>
<td>0.504</td>
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<tr>
<td>Total Hospital Cost per Year Alive</td>
<td>25,487 (499 - 217,540)</td>
<td>70,743 (1,639 - 571,389)</td>
<td>0.504</td>
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<tr>
<td><strong>Total Hospital Cost per Day in Hospital</strong></td>
<td>5,150 (75 - 6,331)</td>
<td>4,471 (3,826 - 6,113)</td>
<td>0.991</td>
</tr>
<tr>
<td><strong>Number of Echo</strong></td>
<td>6 (3 - 9)</td>
<td>3 (1 - 6)</td>
<td>0.016*</td>
</tr>
</tbody>
</table>

Data are presented as median (interquartile range) for continuous data and frequency (percent) for categorical data. P values were calculated using the Wilcoxon rank sum test and Fisher's exact test. *Statistically significant. Cost and charges data was available on n=47 patients.
FIGURE LEGENDS

Figure 1: Referrals to our center from 1985 until October 2023. 62 patients were referred with 34 undergoing operative and 28 non-operative treatment. There has been a steady increase in overall referrals and a majority of patients from the operated group have been treated during the last 5 years (21/34 patients).

Figure 2: There was no difference in STAT category distribution between the 34 operated and 28 non-operated patients (P=0.63).

Figure 3: Survival for Operated patients was significantly higher than Non-Operated patients throughout the study period (P<0.001). Shading indicates 70% confidence intervals.

Figure 4: a) Survival of Operated T13 & T18 vs non-operated. Shading indicates 70% confidence intervals. b) Survival for Operated T18 patients was significantly higher than Non-Operated T18 patients (P=0.006). T13 patients had worse survival compared to T18 patients. Survival for Operated T13 patients was better than Non-Operated T13 patients but was limited by small sample size and was not statistically significant (P=0.06).

Figure 5: Operated T13/T18 patients with CHD had improved survival compared to Non-operated patients.

Central Picture: Operated patient survival was significantly higher than Non-Operated (P<0.001).
Log rank test $P = 0.003$

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Operated</th>
<th>Non-operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>34</td>
<td>28</td>
</tr>
<tr>
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<td>25</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>10</td>
</tr>
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<td>18</td>
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<tr>
<td>4</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>
Evolution of Patient Referrals over Time

Number of Patients

- Operated
- Non-Operated
STAT Category Distribution

Number of Patients

Operated
Non-Operated

STAT 1  |  STAT 2  |  STAT 3  |  STAT 4  |  STAT 5  
--- | --- | --- | --- | ---
20 | 2 | 2 | 4 | 2
Log rank test P = 0.003

Number at risk

<table>
<thead>
<tr>
<th></th>
<th>Operated</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Operated</td>
<td>34</td>
<td>25</td>
<td>23</td>
<td>18</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Non-operated</td>
<td>28</td>
<td>13</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>
Patient Survival (%) vs. Age (years)

- **Operated**
  - Number at risk: 5
  - Demographics:
    - 0 years: 1
    - 1 year: 4
    - 2 years: 4
    - 3 years: 2
    - 4 years: 1
    - 5 years: 1

- **Non-operated**
  - Number at risk: 4
  - Demographics:
    - 0 years: 1
    - 1 year: 1
    - 2 years: 0
    - 3 years: 0
    - 4 years: 0
    - 5 years: 0

Log rank test $P = 0.011$
Number at risk

<table>
<thead>
<tr>
<th></th>
<th>Operated</th>
<th>Non-operated</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>29</td>
<td>24</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
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</tr>
</tbody>
</table>

Log rank test P = 0.024
Operative and Non-Operative Outcomes in Trisomy 13 and 18 Patients with Congenital Heart Disease

Methods
Retrospective chart review of all Trisomy 13 (T13) and Trisomy 18 (T18) patients undergoing primary cardiac repair vs non-operative management at Boston Children’s Hospital from 1985 to 2023.
- 62 patients (34 operated, 28 non-operated) • T13 (n=9), T18 (n=53) • 74% female • 71% STAT 1 cases, most commonly VSD • Median age at OR 2.5 months (IQR 1.3-4.5)

Results
Post-Op median ICU stay 6.5 days (IQR 3.7-15) • Total Hospital LOS 15 days (IQR 11-49) • 30-day Post Op Survival 94% • Median FU 15.4 months (IQR 4.3-48.7) Operated vs 11.2 months (IQR 1.2-48.3) Non-Operated • One-year Operated Survival 79% vs 51.5% Non-Operated P<0.003 • Non-Op Treatment increased risk of mortality (HR=3.28, 95% CI: 1.46, 7.4, P=0.004)

Implications
Cardiac repair can be performed safely with low early mortality and operated patients had higher long-term survival compared to non-operated in our cohort.